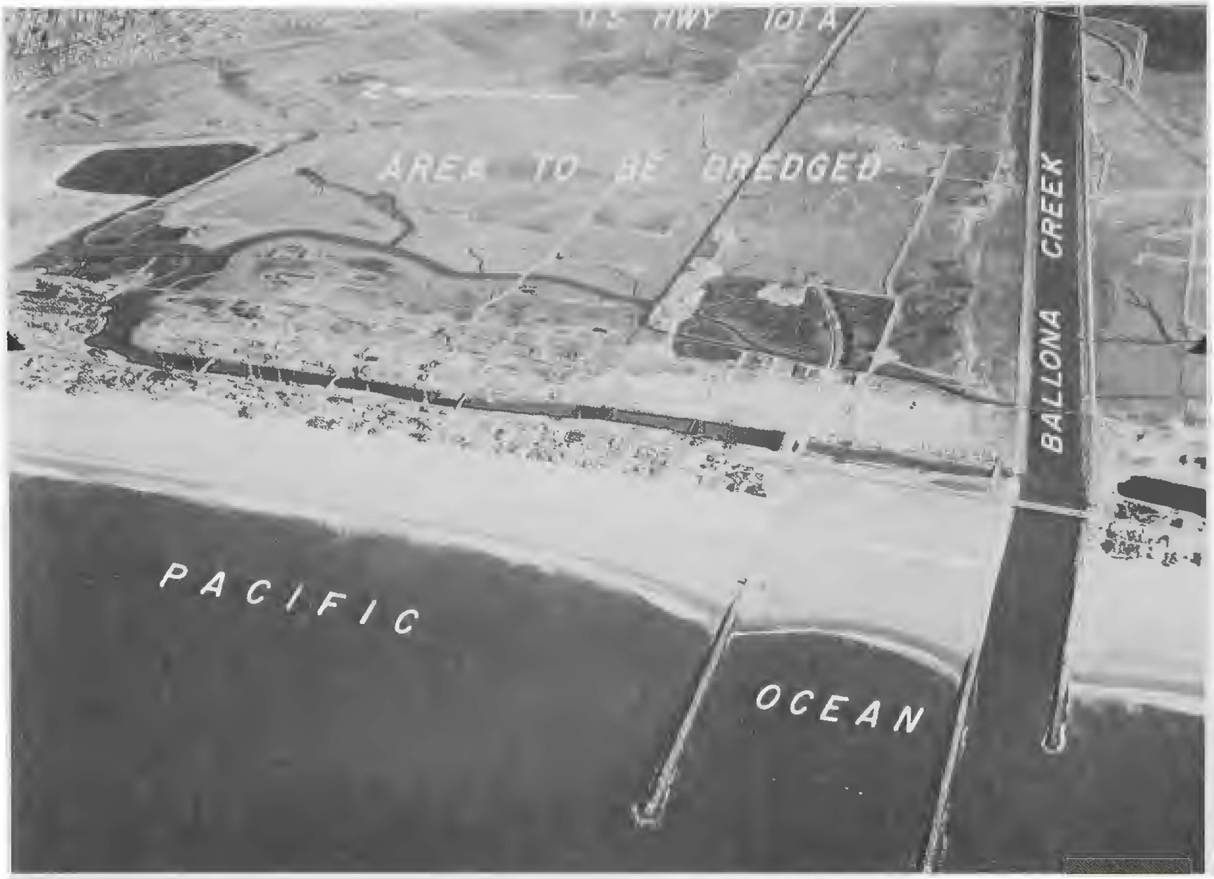
Just to the north of the Los Angeles International Airport lies Marina del Rey, one of the largest and most magnificent small craft harbors in the world, a fitting climax to a story that began in 1886. At that time the efforts of Moye L. Wicks and the Santa Fe Railroad to convert the estuary of Ballona Creek into a major world port failed. In 1916 LAD deemed a proposal to develop the inlet and basin, now named Playa del Rey, into a major harbor as impractical in view of its proximity to major harbors in San Pedro Bay. In the 1930's District officials reiterated that judgment.

By the early 1940's, however, with attention focused on recreational boating, the location of a harbor at Playa del Rey, to provide a badly needed haven for the continually expanding fleet of small boats in Los Angeles County, was again proposed, but World War II temporarily stalled planning for the facility.

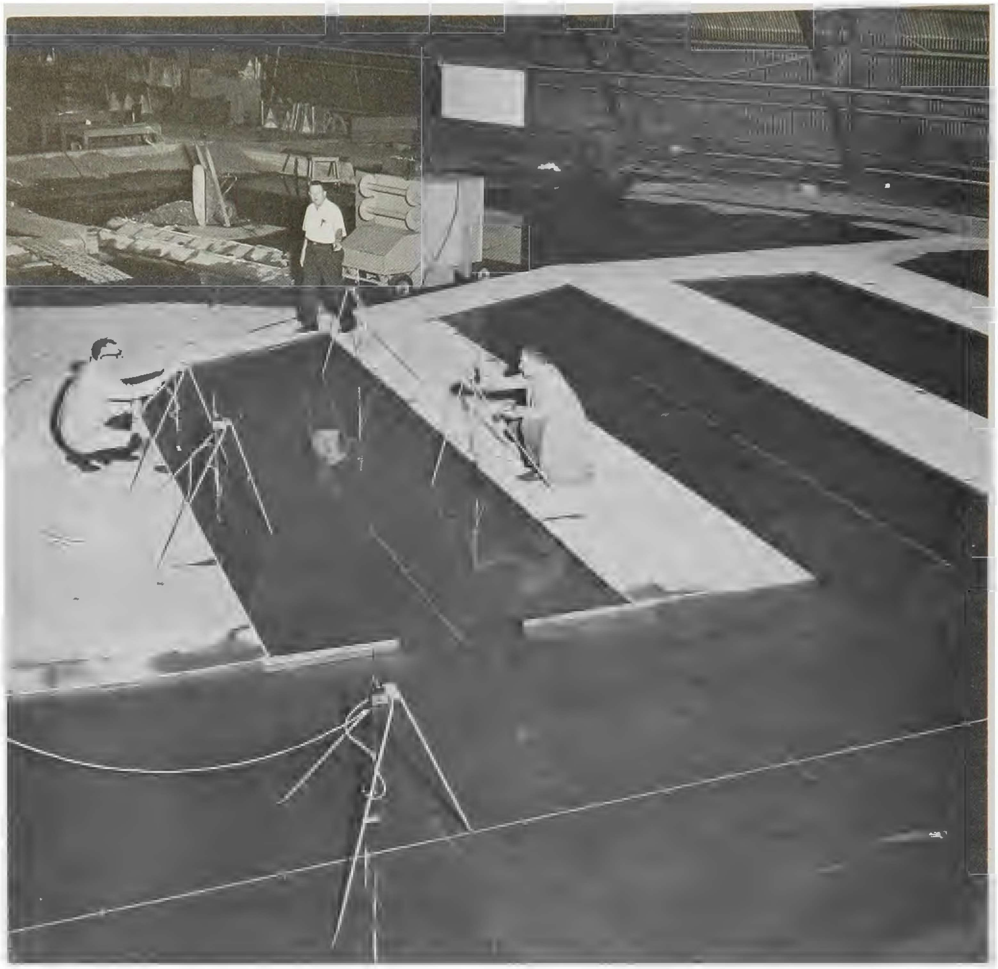
In 1948 LAD submitted a report which demonstrated the feasibility of constructing a small boat harbor, and authorization for the marina was approved in September 1954. The marina was developed as a joint project of LAD and the County of Los Angeles, with additional support from the State of California.

Before a satisfactory haven could be created, major problems had to be resolved. The most serious difficulty appeared after the harbor was placed into operation, when it was found that the harbor was vulnerable to seiche and surge action during heavy storms. The construction of relatively small harbors on open shorelines for frail craft was a new experience for the Coastal Engineering Branch and the Corps of Engineers in general. Therefore, deficiencies were to be expected. In particular Coastal Engineering was confronted with a lack of long term records, no proven method of recording wave direction, insufficient knowledge of how waves are attenuated within the harbor by bottom revetted slopes, or bulkheads, limited knowledge concerning wave energy buildup or dissipation due to interior configurations of the harbor, and lack of design criteria for small boat harbors. To resolve these problems engineers functioned with a phased program, first designing the harbor on the basis of the best information available, then proceeding with construction and evaluation, and finally designing any necessary remedial works.

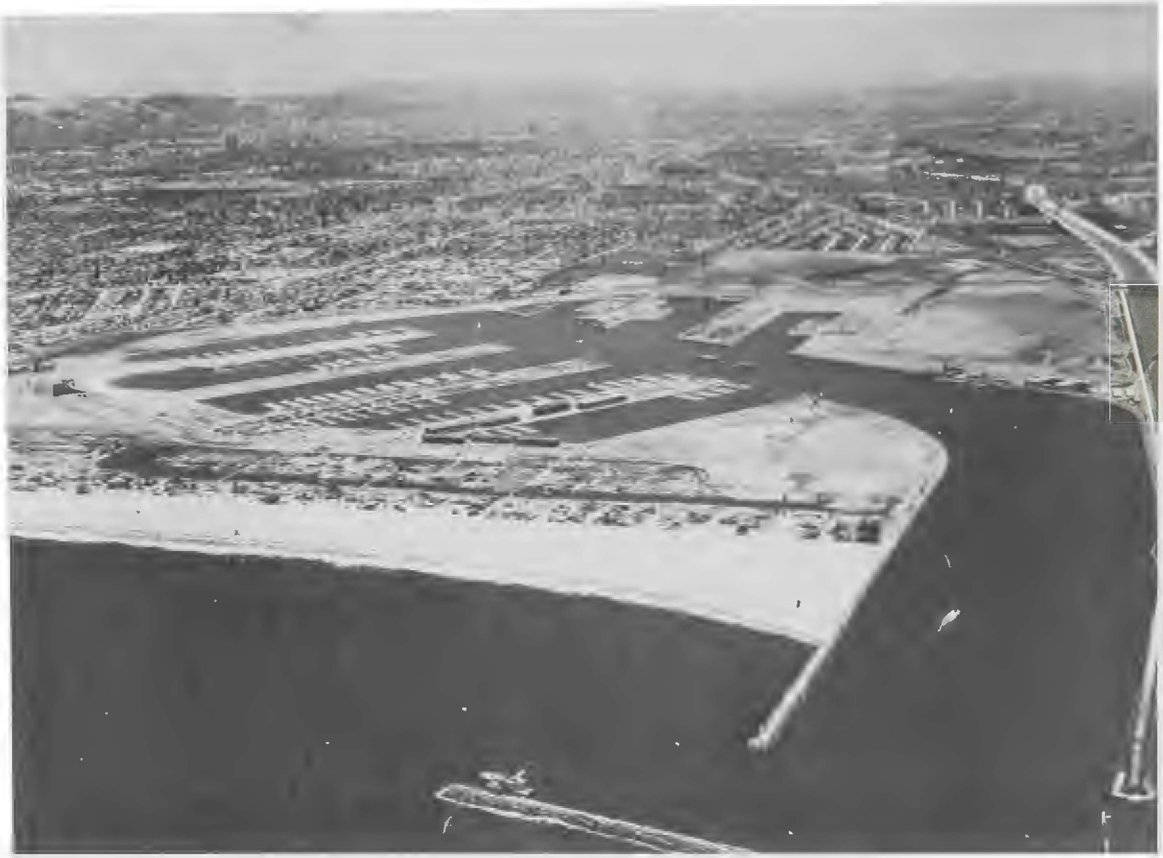
Aware of the vulnerability of the harbor at Marina del Rey to wave action, LAD had underway a model study at the Corps of Engineers Waterways Experiment Station. After the harbor was opened for operation, it suffered severe damage during the winter of 1962-1963. LAD, on the basis of information obtained from the model study, suggested an interim solution to Los Angeles County which was



Marina del Rey under construction, view of completed entrance jetties, area to be dredged, and Ballona Creek flood control channel (Dec. 28, 1959).



Engineers seeking an answer to the surge problem at Marina del Rey position electronic wave recording gages in a scale model of the marina at U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., to test effects of constructed bulkheads at basin entrance.



Marina del Rey Harbor. Dredging and construction of entrance channel, jetties and offshore breakwater by Los Angeles District. Project completed in 1962.

implemented by the construction of temporary protective sheet-pile baffles in the entrance to the channel. The latter provided sufficient protection from wave action until permanent protective structures could be built. Following the lessons learned from the completed model study the engineers constructed an offshore breakwater and the baffles were removed. These remedial measures countered public criticism of the project and preserved the use of the harbor for the residents of Los Angeles County.

As one of the largest small craft harbors in the world, the Marina del Rey is an LAD achievement which matches the success of the large harbor complex of Los Angeles-Long Beach. To a writer in *Westways* (September 1966) the marina was "a near miracle." In addition the project demonstrated healthy cooperation between local, State, and Federal Governments.

Redondo Beach King Harbor, about 10 miles south of Marina del Rey, and also in Santa Monica Bay, was the first Federal recreation harbor to be completed in California after the Korean War. Fittingly, the harbor was named for Congressman Cecil King, for his determination obtained the Federal share of the construction funds for a harbor which began as a WPA project during the thirties. Before the harbor was dedicated on November 16, 1966, Coastal Engineering and consulting engineers had to provide remedial actions for the special problems of this harbor breakwater.

At one time, designers of breakwaters and jetties believed that wave energy produced by breakers and swells was confined to the amount penetrating through the porous upper structure of a breakwater into an inner harbor. The engineers discovered that this wave energy activated surge factors, particularly during storms, which made it impossible to prevent damage to boats or structures within the harbor at Redondo. To combat the seiche and surge during heavy storms, temporary baffles were erected which provided such excellent protection that they were left in place for added safety, although permanent corrective works were later completed by LAD.

To provide these works, Bill Herron and his associates in Coastal Engineering abandoned to some extent the "seat-of-the-pants" engineering and instead adopted a highly sophisticated approach which combined on-site study with several large-scale model tests to obtain designs which resolved some of the problems plaguing the project. The most important finding of the investigations was that a breakwater had to be designed which was relatively impermeable to waves. As Brigadier General John A. B. Dillard, District Engineer, related, Redondo Beach was a historic landmark in producing valuable design principles which were to be utilized in the construction of other small boat harbors.